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THE FOLLOWING IS THE ENGLISH TRANSLATION OF THE AMENDMENTS TO THE CLAIMS OF THE INTERNATIONAL APPLICATION UNDER PCT ARTICLE 19:

AMENDED SHEETS (Pages 2-3a and 8-10)

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Different optical sensors such as photodiodes that are sensitive in the ultraviolet and visible regions can be used advantageously to analyze the stability of this plasma, which stability reflects that of the welding operation.

In the same way, infrared photodetectors placed behind the beam in the displacement direction can be used to measure the intensity emitted by the molten metal. As a general rule, the infrared intensity is an expression of the quantity of heat transferred to the part. Thus increased penetration is expressed by an increase of infrared emission.

Nevertheless, it is difficult to use these different sensors in practice: effectively, the energy received is slight, because the signal decreases in inverse proportion to the square of distance from the source to the sensor. Two solutions are then possible:

- either to use large-diameter optical sensors: but this solution has the disadvantage of leading to a low signal-to-noise ratio. Effectively, the light energy emitted by the capillary originates from a small solid angle, and other undesirable light signals are then captured by the optical components. In practice, it is then very difficult to detect the development of defects in the midst of very noisy signals.
- or to position the sensor close to the weld zone: in this case, the periodic expulsions and condensed metal vapors can degrade the optical components of the sensors fairly rapidly. The local temperature elevation no longer allows the sensor to be placed very close to the molten metal. Palliative techniques have been proposed, based on blowing a lateral gas jet in front of the sensor to protect it, or even protection of the optical components by a consumable transparent plate, which must be changed regularly. These solutions are not satisfactory, however, either from the economic viewpoint or from the viewpoint of signal reliability.

The purpose of the present invention is to resolve the problems cited in the foregoing. It is aimed in particular at providing a control device with which light signals that are emitted by the laser-beam/material interaction and that correspond to the quality of welding, resurfacing or machining can be received with a high signal-to-noise ratio and precise positioning relative to the laser beam, the said device being required to have little sensitivity to the different forms of pollution during

welding, resurfacing or machining, inherent to every industrial environment.

With these objectives in mind, the first object of the invention is a device for controlling the quality of an operation of laser-beam welding, resurfacing or machining of a part, comprising at least one gas-blowing nozzle equipped with a duct for ejection of a flow of the said gas and equipped with at least one photosensitive sensor disposed behind the said ejection duct in such a way that it can receive at least one light signal penetrating into the said ejection duct and emitted during the said operation of welding, resurfacing or machining.

According to a preferred embodiment of the invention, the gas-blowing nozzle comprises a duct placed in the extension of the ejection duct, and the photosensitive sensor is disposed in the said duct.

According to another preferred embodiment, the gas-blowing nozzle comprises a duct placed in the extension of the ejection duct and a lateral duct opening into the said duct, the photosensitive sensor being disposed in the lateral duct, and a reflecting plate is disposed at the junction of the duct and lateral duct in such a way as to deflect the light signal toward the photosensitive sensor.

This reflecting plate is preferably semitransparent.

The device according to the invention may advantageously have one or more of the following characteristics, alone or in combination:

- at least one photosensitive sensor is sensitive to infrared radiation,
- at least one photosensitive sensor is sensitive to ultraviolet radiation,
- at least one photosensitive sensor is isolated from the gas flow by a leak-tight partition that is optically transparent at least in the range of sensitivity of this sensor,
- the device comprises means for filtering and amplifying the output signal of the photosensitive sensor,
- the device comprises means for recording the output signal of the photosensitive sensor.

A second object of the invention is a method for controlling an operation of laser-beam welding, resurfacing or machining of a part, wherein at least one light signal originating from the operation of welding, resurfacing or machining is received by means of the device according to the invention, the variation of this light signal as

CLAIMS

1. A device for controlling the quality of an operation of laser-beam welding, resurfacing or machining of a part, comprising at least one gas-blowing nozzle (1) equipped with a duct (5) for ejection of a flow of the said gas, and equipped with at least one photosensitive sensor (3, 3') disposed behind the said ejection duct (5) in such a way that it can receive at least one light signal penetrating into the said ejection duct (5) and emitted during the said operation of welding, resurfacing or machining.

2. A device according to claim 1, characterized in that the said gas-blowing nozzle (1) comprises a duct (11) placed in the extension of the said ejection duct (5), and in that the said photosensitive sensor (3) is disposed in the said duct (11).

3. A device according to claim 1, characterized in that the said gas-blowing nozzle (1) comprises a duct (11) placed in the extension of the said ejection duct (5) and a lateral duct (11') opening into the said duct (11), the said photosensitive sensor (3') being disposed in the said lateral duct (11'), and in that a reflecting plate (10) is disposed at the junction of the duct (11) and lateral duct (11') in such a way as to deflect the said light signal toward the photosensitive sensor (3').

4. A device according to claim 3, characterized in that the said reflecting plate (10) is semitransparent.

5. A device according to any one of claims 1 to 4, characterized in that the said photosensitive sensor (3, 3') is sensitive to infrared radiation.

6. A device according to any one of claims 1 to 4, characterized in that the said photosensitive sensor (3, 3') is sensitive to ultraviolet radiation.

7. A device according to any one of claims 1 to 6, characterized in that the said photosensitive sensor (3, 3') is isolated from the said gas flow by a leak-tight partition (8) that is optically transparent at least in the range of sensitivity of the said photosensitive sensor (3, 3'),

8. A device according to any one of claims 1 to 7, characterized in that it comprises means for filtering, amplifying and recording the output signal of the said photosensitive sensor (3, 3').

9. A method for controlling an operation of laser-beam welding, resurfacing or machining of a part, characterized in that at least one light signal originating from the said operation of welding, resurfacing or machining is received by means of a device according to any one of claims 1 to 8, in that the variation of the said one light signal as a function of time is compared with at least one reference signal obtained under conditions such that no unacceptable volume or surface defect is present on the said part, and in that acceptance or rejection of the welded or machined part is decided by comparison of the said light signal measured during the said operation of welding, resurfacing or machining and the said reference signal.

10. A method for controlling an operation of laser-beam welding, resurfacing or machining of a part, characterized in that at least one light signal originating from the said operation of welding, resurfacing or machining is received by means of a device according to any one of claims 1 to 8, in that the variation of the said light signal as a function of time is compared with at least one reference signal obtained under conditions such that no unacceptable volume or surface defect is present on the said part, and in that the welding,

resurfacing or machining parameters are automatically controlled as a function of the comparison of the said at least two signals.

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